

Section F. Maneuvering in Rough Weather

Overview

Introduction

WARNING 💖

Don't exceed any vessel operating limits as specified in Standard Boat Operator's Handbooks or through districtuse guidelines for other vessels.

At some time, every boat and crew will encounter wind or sea conditions that challenge safe, successful boat operation. Due to size and design differences, extreme weather for one vessel is not necessarily challenging for another. Also, crew training, experience, and skill more often than not make the difference between safety and danger, regardless of the vessel.

Size, stability, and power are vessel characteristics that enhance safety and allow some forgiveness in large waves and high winds or due to the occasional lapse in skill or judgment. On the other hand, light weight, speed, and agility give a means to avoid or to outrun conditions, but offer little protection or forgiveness for the slightest miscalculation.

Learn to operate your vessel through the full range of conditions you can expect. Begin in light winds and small waves and work up to varied conditions that build your knowledge and confidence.

In this section

This section contains the following information:

Topic	See Page
Using Caution	10-74
Negotiating Head Seas	10-77
Running Before a Sea	10-81
Traversing Beam Seas	10-84
Transiting Harbor Entrances, Inlets, or River Entrances	10-85
Coping with High Winds	10-88
Heaving-To	10-91



Using Caution

F.1. General

Use caution at all times. Never underestimate the power of winds and waves and what they can do to your vessel or crew. The following concepts will increase the level of safety at which you operate.

F.2. Know your vessel

Be familiar with your vessel's operating characteristics and limitations to safely and confidently handle conditions that approach those limits.

F.2.a. Learn your vessel's motions and peculiarities

Operate your vessel frequently and develop a working knowledge of its response to waves and winds. Excessive boat motion is very fatiguing and could cause motion sickness.

- Learn the motions your boat makes in response to the seas. Find out if your vessel has any distinctive tendencies, for instance, attaining a dangerous heel while cresting a wave in high winds, burying the bow in all but the longest swells, or "lightness" to the stern in quartering conditions.
- Learn and develop techniques to minimize vessel motion in all conditions. A small tweak of the throttle or a smooth helm-hand can make the ride much smoother and less fatiguing.
- On smaller vessels, keep crew weight centered around the helm position. This is usually near the boat's center of gravity. It will make the ride more comfortable for the crew and will allow the hull to ride as designed, with more stability, than if weight is in the ends or at the extreme beam.

Common Motions	Description
Pitch	The up and down motion the bow (and stern). In small
	waves at high speeds, pitch can be very small and barely
	noticed. As seas increase, the bow might rise up when it
	meets a wave, and fully clear the water. As it comes back
	down, it immerses to a point on the hull above the
	designed waterline, sometimes with a heavy slam. Pitch is
	usually associated with crossing head seas. Reduce pitch
	by slowing or by taking head seas at more of an angle.



Common Motions	Description
Roll	The side to side motion as each side goes up and down. This is associated with beam seas. A round-bottomed vessel will roll even in near-calm conditions. Reduce roll by setting a course that does not have the seas directly on the beam.
Heave	The vertical motion the entire boat makes. Though frequently hidden by combined pitch and roll, it is felt as a boat encounters large waves or a heavy swell.

F.2.b. Know your vessel's limits

Know what wind speed puts the boat "in irons" with loss of maneuverability. Learn how to heave to and ride out the worst winds or seas.

F.2.c. Ensure proper operation

Don't use a vessel in rough weather when it is not operationally ready. A small discrepancy can lead to serious consequences. Properly stow all required gear and remove everything else. Rough weather will dislodge things.

F.2.d. Only use the right vessel

When conditions exceed a particular vessel's limits, use a more capable vessel. If one is not available, tell higher authority. Don't use the wrong tool for a job. Always apply risk assessment.

F.3. Know your area

Learn to handle your vessel in the types of winds and seas found in your specific area. Learn their interaction with local geography and hydrography.

F.3.a. Observe all areas beforehand

Learn your area's tide rips, bars, gorges, coastal currents and local waters before you must maneuver there in rough weather.

Step	Procedure
1	Find out where wind funnels between headlands or in a river
	constriction.
2	Get the "big picture," if possible. Spend time in a watch tower or on an overlook, map the patterns of waves, where and when they
	break.
3	Follow the tracks of severe storms or squall lines. Learn how local
	geography affects their motion, winds or intensity.



Step	Procedure
4	Pay attention to forecasts, then frequently compare to actual
	conditions in your area.
5	Know location to points, capes, bars, hazards to navigation, i.e.,
	piers, wreck, submerged piles, etc.

F.3.b. Observe before you act

Evaluate on scene conditions before committing to a maneuver.

Step	Procedure
1	Time the series of waves, note relative lulls between the large
	ones, any places where the waves don't curl and break with
	intensity, or where they seem to peak and break continuously.
2	Note if an approaching thunderstorm has a wall cloud or if a
	"downburst" is visible.
3	Determine the best way to lessen the effect of a sudden, extreme
	gust of wind.

F.4. Know yourself and your crew

You and your crew have limitations. Know what they are. Be aware of the human factors and clues associated with risk management. False bravado or over-confidence in rough weather will not compensate for inexperience or fear. The following are common sense guidelines to follow:

- When in doubt, don't. Experience helps hone good judgment in risk assessment.
- **Understand your responsibility**. Rough weather is not a game or a sport. Use your head.
- **Know when to end an evolution**. This is particularly true in training. Damage or injury during training removes resources and people from operational availability.
- **Perform as a team**. While the coxswain concentrates on the detailed maneuvering, the crew must act as an additional eyes and ears.



Negotiating Head Seas

F.5. General

Use your vessel's inherent capabilities. Bow flare provides additional buoyancy to help lift the bow, but you must meet larger seas much slower than you would smaller ones. A slower speed of approach gives the bow time to rise and meet the wayes.

NOTE &

The following parts on maneuvering are general in nature. Remember that each specific boat type will perform differently.

NOTE &

Keep in mind that aerated, broken, sloughing, or "white" water will not provide as much buoyancy as "green" water. Also, propulsion and helm response will be sluggish. Aerated water favors cavitation.

F.6. Maneuver constantly

Look and drive for the path of least resistance. The best way to get through waves is to avoid as many as possible. Anticipate patterns and take advantage of them.

F.6.a. Breaking waves

Pick your way around breaking waves. Take advantage of any lulls between the higher series of waves. Look for gaps or windows in the breaking waves, but watch them to see if they close out before you approach. Don't try to steer a perfectly straight course, steer the smoothest course.

F.6.b. Crests

Avoid the highest crests. Stay away from waves that begin to peak in a triangular fashion. A "square" wave leaves no room to maneuver, and the trough behind is much deeper than others.

F.7. Working over waves

Work your way over each wave individually. Vary speed and angle of approach to account for differences in each wave.



NOTE &

If you must go through a breaking wave, keep headway. Just as the breaking sea hits the bow, increase power to lift the bow so the sea will not spill on deck, then immediately reduce power.

Step	Procedure
1	Slow down, approach at an angle. Too much speed could "launch"
	a boat as it leaves a crest and result in a severe drop. Approach at
	a 10-25 degree angle to the wave rather than straight into it. Cross
	the crest at this angle to stay in the water and keep the propellers
	and rudders working.
2	Stay ready to maneuver. You may have to straighten out quickly
	or to "fall off" to avoid a forming break.
3	Continually adjust boat speed. Increase speed to keep the screw
	and rudder or drive in the water and working, but then
	immediately reduce it to minimize wave impact.
4	Don't drive the bow into the wave.

NOTE &

If the sea is about to break directly ahead and plunge onto the bow, back down squarely and quickly to avoid the plunging water. The boat will settle as the aerated froth passes, and propulsion and steering will lose some effectiveness until the white water passes.

CAUTION!

Don't use so much power to cause cavitation when backing away from a wave. If you cavitate, you will lose all thrust and maneuverability.

WARNING 💖

If your vessel is a single-screw, don't attempt this if you were originally going to take the wave on the port bow. Backing down will throw the stern to port and the vessel could end up beam-to the crashing wave.

F.8. Manage your power

Keep one hand constantly on the throttle control(s).

F.8.a. Heavier vessels

Use the following procedures when managing the power of heavier vessels.



Step	Procedure
1	Use only enough power to get the bow sections safely over or
	through the crest.
2	Let momentum carry, and cut back power to let the boat slide
	down the back side of the swell. When the stern is high, gravity
	pulls the boat downward and the engines may race somewhat, but
	stay in gear. Don't decrease RPMs to the point where the engines
	need time to "spool up" to regain enough power to deal with the
	next wave.
3	Increase speed in the trough to counteract the reversed water flow
	and maintain directional control as the next wave approaches.
4	Slow down again and approach the next wave.

(including RIBs)

F.8.b. Lighter Craft Use the following procedures when managing the power of light craft.

Step	Procedure
1	Use enough power to get the entire boat safely over or through
	the crest. Lighter craft will not carry momentum so constant
	application of power is necessary.
2	Keep a slight, bow-up angle at all times.
3	Once through the crest, a slight, bow-up angle, will let the after
	sections provide a good contact surface if the boat clears the
	water. A bow up attitude will help to approach the next wave.
4	Increase speed in the trough to counteract the reversed water flow
	and maintain directional control as the next wave approaches.
5	Slow down again and approach the next wave.

F.9. Stay in the water

Don't "fly through" the crest. Avoid this at all costs.

- If airborne coming through a wave with a large vessel, you threaten your crew with serious injury and could damage the vessel when it lands.
- With lighter craft, ensure the after sections stay in contact with the water, but don't let the bow sections get too high. If the bow sections get too high while going through a crest, the apparent wind or the break can carry the bow over backward. On the other hand, if forward way is lost with the stern at the crest. the bow might fall downward, requiring you to redevelop speed and bowup attitude before the next wave approaches.



F.10. Hold on but stay flexed

Keep a firm grasp on controls or hand holds, but don't rigidly brace yourself. Staying rigid and tense will quickly sap your strength. If standing, keep your knees flexed.



Running Before a sea

F.11. General

A following sea does not present the high relative closure rate of head seas, but keeping vessel control and stability is probably more challenging.

Operation in a following sea, especially a breaking sea, involves the risk of having the stern lifted up and forced forward by the onrushing swell or breaker. Surfing down the face of a wave is extremely dangerous and nearly impossible to control. Quite often, surfing will force the boat to "broach" and capsize or to "pitchpole" end over end. Through proper boat handling, a skilled coxswain may be able to keep a vessel ahead of breaking seas while maintaining control of both direction and speed. Only specially designed vessels like motor life boats have balanced buoyancy and sea keeping abilities to handle extremely rough weather, including large, breaking, following seas. Vessels as this also have the ability to quickly reright after capsize.

F.12. Use extreme caution

Be very careful when running in a large following sea. Some boats slip down the back of seas and heel strongly. In large stern seas, the rudder may get sluggish. Depending on the vessel, make your down-swell heading anywhere from directly down-swell to a 15 degree angle to the swells.

NOTE &

A great deal of skill is needed to maintain a heading in large, quartering seas (30-45 degrees off the stern), especially in restricted waters. In addition to the action from astern, the forces from abeam will set up a rolling action that causes large changes in the vessel's underwater hull shape (on anything except a round-bottomed, displacement hull). This causes asymmetric forces that increase steering difficulty, could set up "chine-riding," loss of effective helm, and a pronounced veer to the side as the vessel begins to surf along the face of the wave. Even in open water, quartering seas present a challenge.



F.13. Ride the backs of the swells

In waves with a wide regular pattern, ride the back of the swell. Never ride on the front of a wave. On most vessels, wider and flatter after hull sections are more buoyant than the bow. On the front of a wave, the boat may begin to surf, pushed along by the wave. As the bow nears the wave trough, it will tend to "dig in" while stern continues to be pushed. This sets up either a broadside "broach" or an end-for-end "pitchpole" as the breaking crest acts on the boat.

CAUTION!

Don't let a wave break over the transom and poop the boat. Be extremely careful in small craft with outboard motors, the relatively low transom-well offers little protection from even a small, breaking wave. A wave that breaks over the transom could fill the cockpit with water and swamp the boat. Without self-bailing, this leaves you vulnerable to capsize by the next wave.

F.13.a. Where to look

Keep an eye both ahead and astern. If you totally concentrate on the wave ahead, you let your guard down on waves from astern. Since larger waves travel faster than smaller ones, one much larger than the one you are on may move up quickly from astern and catch you unaware.

F.13.b. Speed

Adjust your speed to stay on the back of the swell. Pay extremely close attention to the way the crest ahead of you breaks. If you keep gaining on the crest ahead, slow down.

WARNING 💖

Many small craft can travel faster than the largest waves. Don't keep climbing the back of a large wave ahead to its crest. The boat could go over the crest just as it breaks and fall into the trough under the plunging water.



F.14. Keep reserve power

Large seas run at over 20 knots. If the boat is being pulled back towards a following sea, open the throttle. If the boat is still pulled back, watch for "mushy" helm response and engine racing. If either happens, reduce throttle, then apply full throttle to try to kick out of the wave.

F.15. Slow, back or come about

If running with the seas and one is gaining astern, avoid it breaking on the transom.

WARNING 💖

Coming about in large seas can be dangerous. It puts the boat beam-to the seas. Don't try this unless well trained and experienced. Any close, steep swells will test all your skills. Sluggish rudder, sail area, and irregular waves may cause the stern to slew off and result in a broach.

Step	Procedure
1	Slow Down: with a well-found vessel, you may be able to just
	slow enough so the crest passes by before it breaks. This will
	cause some loss of positive steering and propulsion control as the
	crest passes because the water in the crest will be moving forward
	faster than the boat.
2	Back Down: you may need to back and gain sternway to steer
	before the crest reaches the screws and rudder, particularly if the
	wave breaks and aerated water will slough past.
3	Come About: the safest point for most vessels to take a breaking
	sea is nearly bow-on. Always stay aware of the time and distance
	between crests. If time and distance allow, come about and present
	the bow to the sea with headway.

CAUTION!

If you must come about before a wave, use judicious helm and throttle. Too much throttle, especially when splitting throttles, could easily result in cavitation and leave no positive control in the face of the oncoming sea.



Traversing Beam Seas

F.16. General

In large beam seas, the wave action will cause the boat to roll. The rolling will cause asymmetric hydrodynamic forces and will affect steering. Do your best to keep drive and rudder immersed.

F.17. Breaking waves

Minimize the number of breaking waves you encounter. If traversing near a surf zone, go farther out into deeper water.

F.18. Use your local knowledge

Avoid areas that break when no other areas do. Offset your transit from areas of shifting bars.

NOTE &

If you must operate in the surf zone, complete wave avoidance is not possible. The coxswain must be totally involved in operating the boat while the crew carries out the details of the mission (search, recovery, etc.).

F.19. Keep a weather eye to the waves

As with head seas and following seas, the boat will be pulled towards the next, oncoming wave while in the trough, and set down-swell by the crest.

	Waves
1	Look for a lull in the series to cross seas. If necessary, slow to
	allow a large series of waves to cross ahead.
2	Use caution to avoid a forming break. Watch how the waves
	break. Plan to cross an oncoming wave well before it begins to
	break. Don't get caught racing a break to cross at a particular
	point. Use procedures for negotiating head seas to cross oncoming
	waves. As with head seas, cross them at the lowest part.
3	Never get caught broadside to a breaking sea. A breaking swell
	taken on the beam can easily capsize the most well-found vessel.
4	Don't get trapped. If the boat gets into closer and closer seas, look
	for an out. If shallow water or a current against the seas is on one
	side, work your way in the other direction.



Transiting Harbor Entrances, Inlets, or River Entrances

F.20. General

Transiting harbor entrances, inlets, or river entrances in rough weather. You will encounter times when you must either leave or enter port in challenging conditions. Though certain locations have extreme conditions much more often than others, learn how rough weather affects the various harbors and entrances throughout your local area. Methods covered above for maneuvering in head, following, and beam seas still apply, but the entrance areas add additional consideration.

F.21. Know the entrance

Though mentioned above, local knowledge is key. Know as much as possible before transiting an entrance in rough weather.

Step	Procedure
1	Watch where waves break. Know how far out into the channel,
	whether near jetties, or shoals or directly across the entrance the
	waves break.
2	Pay close attention to how the entrance affects wave patterns. A
	jettied entrance may reflect waves back across an entrance where
	they combine with the original waves.
3	Some entrances have an outer bar that breaks, then additional
	breaks farther in. Others are susceptible to a large, heaving motion
	that creates a heavy surge as it hits rocks or structures.
4	Know where the channel actually is. If shoaling has occurred,
	room to maneuver may be significantly lessened.
5	Know the actual depths of the water. Account for any difference
	between actual and charted depth due to water stage, height of
	tide, recent rainfall, or atmospheric pressure effects.

F.22. Transit when current opposes the seas

This presents the most challenging situation near an entrance. In opposition to the seas, a current has the effect of shortening the wavelength, without reducing the wave height. This makes waves much more unstable and much closer together.

Step	Procedure
1	When going into the seas, the current behind will push the boat
	into them, at a relatively higher speed.
2	Reduce the effect (which will also give more time to react between
	waves) by slowing, but because the current is behind, keep enough
	headway to ensure effective steering.



Step	Procedure
3	Don't let the current push the boat into a large cresting wave,
	combined waves peaking together. In an entrance, maneuvering
	room is often limited. The only safe water may be where you have
	just been. Stay ready to back down and avoid a breaking crest.
4	In following seas and a head current, the situation can be critical.
	The waves will overtake at a higher rate, they become unstable
	more quickly, and will break more often. The current reduces the
	boat's progress over the ground, subjecting you to more waves.
5	As with all following seas, stay on the back of the wave ahead of
	you. Because the waves become unstable and break more quickly,
	use extra caution not to go over the crest ahead. Concentrate both
	on the crest ahead and the waves behind.
6	Keep a hand on the throttle and adjust power continuously. In
	many entrances, there is not enough room to come about and take
	a breaking wave bow-on. Anticipate. If a wave looks to break, the
	only out may be to back down before it gets to you.
7	Stay extremely aware of any wave combinations and avoid spots
	ahead where they tend to peak. If they peak ahead in the same
	place, chances are they will peak there when you are closer.
	However, don't let a slightly different wave or wave combination
	catch you by surprise.
8	The crew must keep an eye on the situation and pass information
	freely.

F.23. Transit when current and seas coincide

Here, a current has the effect of lengthening the waves. Longer waves are more stable, with the crests farther apart, but caution is still needed.

Step	Procedure
1	When going into the seas and current, progress over the ground
	will be less, so you will spend more time in the entrance.
	Increasing boat speed may be warranted.
2	Don't increase boat speed so that negotiating waves becomes
	hazardous. The waves are just as high, so if you increased overall
	speed, reduce speed to negotiate each crest individually.



Step	Procedure
3	With following seas and a tail current, speed over the ground will
	be increased., Because the waves are farther apart, the task of
	riding the back of the wave ahead should be easier. Because the
	current is behind, more forward way will be required to maintain
	steering control.
4	As with all following seas, stay on the back of the wave ahead of
	you. Don't be lulled into a false sense of security. With higher
	speed over the ground and less maneuverability due to the
	following current, there is not as much time to avoid a situation
	ahead.
5	Keep a hand on the throttle and adjust power continuously.
6	Because you will spend less time in the entrance, stay extremely
	aware of any spots ahead to avoid. Maneuver early as the current
	will carry the boat.
7	The crew must keep an eye on the situation and pass information
	freely.



Coping with High Winds

F.24. General

Though preceding discussions dealt with encountering severe wave action, high winds don't always accompany large swells. Also, there will be instances when extreme winds occur without sufficient duration to make large waves. Much of the time, though, high winds and building seas will coincide

F.25. Crab through steady winds

Depending on the vessel's sail area, you may need to steadily apply helm or asymmetric propulsion to hold a course in high winds. Learn to "read" the water for stronger gusts. The amount of chop on the surface will increase in gusts, and extremely powerful gusts may even blow the tops off waves. Anticipate the effect of a gust before it hits your vessel.

NOTE &

Boats that show extreme motion and minimal control in high winds and seas, regardless of size and power are not well suited for missions in these conditions. If caught in marginal conditions, safety of own vessel and crew must be the only concern. Other, more capable resources must conduct the mission.

Step	Procedure
1	In large waves, the wave crest will block much of the wind when
	the boat is in the trough. Plan to offset its full force at the crest.
	The force of the wind may accentuate a breaking crest, and require
	you steer into the wind as you near the crest in head seas.
	Depending on the vessel, winds may force the bow off to one side
	as you cross the crest.
2	For light vessels, the force of the wind at the wave crest could
	easily get under the bow sections (or sponson on a RIB), lift the
	bow to an unsafe angle, or force it sideways. Though a light vessel
	must keep some speed to get over or through the crest of a large
	wave, don't use so much speed that as you clear the crest, most of
	the bottom is exposed to a high wind. Be particularly cautious in
	gusty conditions and stay ready for a sudden large gust when
	clearing a wave.
3	With twin-engined craft, be ready to use asymmetric propulsion to
	get the bow into or through the wind. As with all other maneuvers,
	early and steady application of power is much more effective than
	a "catch-up" burst of power.



Step	Procedure
4	Vessels with large sail area and superstructures will develop an
	almost constant list during high winds. In a gust, sudden heel, at
	times becoming extreme, may develop. This could cause handling
	difficulties at the crest of high waves. If your vessel exhibits theses
	tendencies, exercise extreme caution when cresting waves. You
	must learn to safely balance available power and steering against
	the effects of winds and waves.

F.26. Avoiding severe weather

Avoid thunderstorms, downbursts, squalls and waterspouts. Many areas regularly get severe weather with localized winds in excess of fifty knots. As these conditions often arise at peak times in the recreational boating season, chances are that you may find yourself underway in them. Since numerous cells can occur in one thunderstorm, you may be faced with maneuvering among many, different storms. Keep an eye on what is approaching.

NOTE &

If faced with a severe storm while on the water, reduce as much sail area as possible. Lower bimini tops, dodgers, outriggers, antennas, flags and ensigns. This significantly improves vessel stability and response to high winds. Also, stow all loose gear, close hatches and doors, and stay low.

F.26.a. Gusts

NOTE &

If sea-room permits, move away from (perpendicular to) the direction of the gust. Try to avoid the highest gusts. Some storm cells have their own gust fronts that precede them. Look for what appears to be a layer of steam on the water. A fifty-knot gust front will actually turn the surface of the water into spray, with the highest gusts mixing with the relative heat of the water to lift the spray vertically.

F.26.b. Drifting stern-to the winds

Consider drifting stern-to the winds. At the speed these gusts move, they often don't have time to develop much of a sea. If so, you may be able to lie safely, stern-to the wind, engines in neutral. This way, you will not have to fight the overpowering force to keep the bow directly into the wind.



F.26.c. Getting between a storm and shore

Don't get between a severe storm and a near, lee shore. Work your way across a gust front, before it arrives, as best possible to safe haven or open water.

CAUTION!

Laying stern-to is not safe if an approaching storm has enough open water to develop fetch and build seas. A strong thunderstorm needs as few as five miles of open water to build a three- to four-foot chop. In combination with fifty-knot winds, this chop can easily swamp small vessels.



Heaving-To

F.27. General

Heave-to when necessary. If unable to reach safe haven in extreme weather, heaving-to might be the only option to ride out conditions. Basically, heaving to is putting the bow into the wind or seas, and holding it there with helm and throttle. For vessels with a large sail area or superstructure, this might not be possible, as every wave or gust of wind may cause the vessel to "fall-off" the wind and lie beam-to or stern-to.

F.28. Maneuvering

Maneuver only to keep a bow-on aspect to the weather. Heave-to only because you cannot safely make progress in a desired direction.

WARNING

Only heave-to when there is adequate sea room to leeward. Drift will be downwind and down sea.

Step	Procedure
1	Offset for the strongest force. Wind and seas might not be from
	exactly the same direction.
2	Try to keep seas between 10 and 25 degrees off the bow as if
	negotiating head seas and note the compass heading. You will still
	negotiate the seas, but not make any progress. If the wind allows
	holding this angle, it will give the best ride. Determine a mix of
	helm and throttle to hold the heading, try not to use full rudder or
	throttle as it leaves no reserve for an emergency maneuver.
3	If the winds are gusty and have frequent shifts, they can easily
	force the bow off the desired heading. Listen for signs of an
	approaching gust and start to counteract its effect before it
	actually strikes the boat.
4	If seas are not the strongest force, keep the bow directly into the
	wind.

F.29. Sea Anchor

Use a sea anchor if necessary. If unable to hold a heading, use a drogue as a sea anchor, made fast to the bow, to hold it into the weather. Use as much scope as available up to 300 feet. Let the rode pay out and see whether the vessel motions settle down. The bow may continue to "sail" back and forth. Counteract this by using some ahead power and helm to hold the bow at a constant compass angle.

